Surds Questions

8 (a) $\boxed{\text{Simplify } \frac{10}{3\sqrt{5}}}$

To simplify a surd we need get rid of the square root in the denominator.

WE NEVER WANT A ROOT ON THE BOTTOM OF A FRACTION.

$$\frac{10}{3\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}} = \frac{10\sqrt{5}}{3\underbrace{\sqrt{5}\times\sqrt{5}}_{=5}} = \frac{10\sqrt{5}}{3\times 5} = \frac{10\sqrt{5}}{15} = \frac{2\sqrt{5}}{3}$$

Divide top and bottom by 5.

We can multiply by $\frac{\sqrt{5}}{\sqrt{5}}$ because as long and we apply the same to top and bottom it doesn't change the value of the fraction. THIS ONLY APPLIES TO MULTIPLICATION AND DIVISION! Not adding or subtracting.

(b) $\boxed{\text{simplify } \sqrt{396}}$

We can split up square roots:

$$\sqrt{ab} = \sqrt{a} \times \sqrt{b}$$

$$\sqrt{396} = \sqrt{\underbrace{36 \times 11}_{36 \times 11 = 396}} = \sqrt{36} \times \sqrt{11} = 6 \times \sqrt{11} = 6\sqrt{11}$$

(c) $\boxed{\text{simplify } \frac{3\sqrt{7}}{4+\sqrt{7}}}$

If we just multiplied this by $\sqrt{7}$ we'd still be left with '$4\sqrt{7}+7$' on the bottom. So we have to use the difference of two squares in this case.

Notice we have changed the sign.

$$\frac{3\sqrt{7}}{4+\sqrt{7}} \times \underbrace{\frac{4-\sqrt{7}}{4-\sqrt{7}}}_{=1} = \frac{3\sqrt{7}(4-\sqrt{7})}{(4+\sqrt{7})(4-\sqrt{7})}$$

= 1 so we aren't changing the fraction

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(c cont.)

$$\frac{3\sqrt{7}(4-\sqrt{7})}{(4+\sqrt{7})(4-\sqrt{7})} = \frac{12\sqrt{7} - (3\times7)}{16 \underbrace{-4\sqrt{7}+4\sqrt{7}}_{\text{These cancel each other}} -7} = \frac{12\sqrt{7}-21}{16-7} = \frac{12\sqrt{7}-21}{9} = \frac{4\sqrt{7}-7}{3}$$

(d) $\boxed{\text{Simplify } \dfrac{(4-\sqrt{3})(4+\sqrt{3})}{\sqrt{13}}}$

First expand out the top so we can see what we've got.

$$\frac{(4-\sqrt{3})(4+\sqrt{3})}{\sqrt{13}} = \frac{16 \overbrace{-4\sqrt{3}+4\sqrt{3}}^{\text{These cancel}} -3}{\sqrt{13}} = \frac{16-3}{\sqrt{13}} = \frac{13}{\sqrt{13}}$$

Now get rid of the root on the bottom

$$\frac{13}{\sqrt{13}} \times \frac{\sqrt{13}}{\sqrt{13}} = \frac{13\sqrt{13}}{13} = \sqrt{13}$$

Divide top and bottom by 13.

(e) $\boxed{\text{Simplify } (\sqrt{a}+\sqrt{4b})(\sqrt{a}-2\sqrt{b})}$

Expand out:

$$(\sqrt{a}\times\sqrt{a}) + (\sqrt{a}\times -2\sqrt{b}) + (\sqrt{4b}\times\sqrt{a}) + (\sqrt{4b}\times -2\sqrt{b})$$

$$= a + -2\sqrt{a}\sqrt{b} + \sqrt{4}\sqrt{a}\sqrt{b} + -2\sqrt{4}\sqrt{b}\sqrt{b}$$

$$= a \underbrace{- 2\sqrt{a}\sqrt{b} + 2\sqrt{a}\sqrt{b}}_{\text{These cancel each other}} - 2\times2\times b$$

$$= \underline{\underline{a - 4b}}$$

(f) $\boxed{\dfrac{1}{1+\frac{1}{\sqrt{2}}}}$

A fraction in a fraction doesn't change anything, still use difference of two squares.

$$\frac{1}{1+\frac{1}{\sqrt{2}}} \times \frac{1-\frac{1}{\sqrt{2}}}{1-\frac{1}{\sqrt{2}}} = \frac{1-\frac{1}{\sqrt{2}}}{\left(1+\frac{1}{\sqrt{2}}\right)\left(1-\frac{1}{\sqrt{2}}\right)} = \frac{1-\frac{1}{\sqrt{2}}}{1+\underbrace{\frac{1}{\sqrt{2}}-\frac{1}{\sqrt{2}}}_{\text{These cancel}}-\frac{1}{2}}$$

$$= \frac{1-\frac{1}{\sqrt{2}}}{1-\frac{1}{2}} = \frac{1-\frac{1}{\sqrt{2}}}{\frac{1}{2}} \times \frac{2}{2} = \frac{2\left(1-\frac{1}{\sqrt{2}}\right)}{1} = 2\left(1-\frac{1}{\sqrt{2}}\right)$$

$$= 2 - \left(\frac{2}{\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}}\right) = 2 - \frac{\cancel{2}\sqrt{2}}{\cancel{2}} = \underline{\underline{2-\sqrt{2}}}$$

(g) $\boxed{(1+\sqrt{3})^2}$ Expand out.

$$(1+\sqrt{3})(1+\sqrt{3}) = 1+\sqrt{3}+\sqrt{3}+3 = \underline{\underline{4+2\sqrt{3}}}$$